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EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/781,040
Filing Date: February 18, 2004
Appellant(s): LUBOMIRSKY ET AL.

Keith Tackett
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed August 30, 2006 appealing from the Office action mailed April 5, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

The statement of the status of claims contained in the brief is correct.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6582578	Dordi et al.	10-2000
2003/0057098	Sendai et al.	1-2002
2002/0084189	Wang et al.	1-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 25 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 25 recites "the anode is not tilted". This limitation is deemed to be new matter, since the disclosure does not provide a clear indication to support these limitations.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-4, 8-9, 12-16 and 20-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dordi et al. '578 in view of Sendai et al.

Regarding claims 1 and 8, Dordi et al. '578 teach an electroplating method, comprising: loading a substrate into a receiving member (column 33 lines 33-47); tilting the receiving member to a first tilt angle measured from horizontal (column 34 lines 30-54); displacing the receiving member toward the fluid solution at the first tilt angle (column 34 lines 55-64); reducing the tilt angle to about horizontal once the substrate contacts the fluid solution; and tilting the receiving member to a second tilt angle or processing angle (column 38 lines 41-57) measured from horizontal when the substrate contacts the fluid solution, the second tilt angle being different from the first tilt angle.

Dordi et al. '578 differs from the instant claims in that the reference teaches positioning the substrate parallel to the surface of the anode but does not explicitly disclose tilting the anode.

Sendai et al. teach an electroplating method wherein the tilt angle is greater than 0 degrees at a time when the substrate becomes completely immersed in the fluid solution (paragraph 25); the anode is tilted from horizontal at an angle of between about 1 and 10 degrees (paragraph 91); and the central axis of the substrate proximate is centered on the electrolyte solution (figures 11-12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by tilting the anode as taught by Sendai et al., because tilting the anode would prevent air bubbles from remaining on the surface to be plated and would enhance plating uniformity.

Addressing claims 21 and 22, it would have been obvious to one having ordinary skill in the art at the time the invention was made to recognize that the intermediate position of the substrate would be parallel to the surface of the anode when the anode is tilted at an angle as taught by Sendai et al. while the tilt angle of the substrate is reduced to horizontal as disclosed by Dordi et al. '578, since the tilt angle of the substrate would overlap the angle of the anode.

Regarding claims 2 and 12, Dordi et al. '578 teach an electroplating method wherein the first tilt angle is between about 0 and 90 degrees (column 35 lines 41-48), which is within the range of the instant claim.

Regarding claims 3 and 13, Dordi et al. '578 teach an electroplating method wherein the second tilt angle is horizontal or about 0 degrees (column 38 lines 41-57).

Regarding claims 4 and 9, Dordi et al. '578 teach an electroplating method wherein the receiving member is rotated at a rotation rate of between about 0 rpm and about 200 rpm (column 38 lines 62-67).

Addressing claim 14, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by tilting the substrate when the substrate is completely immersed in the fluid solution as taught by Sendai et al., because it would prevent air bubbles from remaining on the surface to be plated and prevent plating film defects.

Regarding claim 15, Dordi et al. '578 teach an electroplating method, comprising: positioning the substrate on a contact ring (column 33 lines 33-47); securing the substrate to the contact ring with a thrust plate assembly (column 33 lines 33-47); tilting the contact ring to a tilt angle of between 0 and 90 degrees (column 35 lines 41-48), which is within the range of the instant claim; vertically actuating the contact ring toward the plating electrolyte while maintaining the tilt angle (column 34 lines 55-64); rotating the contact ring at a rotation rate of between about 0 rpm and about 200 rpm (column 38 lines 62-67); reducing the tilt angle to about horizontal (column 38 lines 41-57) when the contact ring initially touches the plating electrolyte; and positioning the substrate in a processing position (column 38 lines 41-57).

Dordi et al. '578 differs from the instant claims in that the reference teach positioning the substrate parallel to the surface of the anode but does not explicitly disclose tilting the anode.

Sendai et al. teach an electroplating method wherein the tilt angle is greater than 0 degrees at a time when the substrate becomes completely immersed in the fluid solution (paragraph 25); the anode is tilted from horizontal at an angle of between about 1 and 10 degrees (paragraph 91); and the central axis of the substrate proximate is centered on the electrolyte solution (figures 11-12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by tilting the anode as taught by Sendai et al., because tilting the anode would prevent air bubbles from remaining on the surface to be plated and would enhance plating uniformity.

Regarding claim 16, Dordi et al. '578 teach an electroplating method wherein the second tilt angle is horizontal or about 0 degrees (column 38 lines 41-57).

Addressing claim 20, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by maintaining the central axis of the substrate proximately centered on the electrolyte solution as taught by Sendai et al., because it would enhance plating uniformity.

Regarding claim 23, Dordi et al. '578 teach an electroplating method, comprising: loading a substrate into a receiving member (column 33 lines 33-47); tilting the receiving member to a first tilt angle measured from horizontal (column 34 lines 30-54);

immersing the substrate into the plating solution (column 34 lines 55-64); and pivoting the receiving member from the first angle to an intermediate position to a second angle while maintaining the substrate immersed in the plating solution (column 38 lines 24-26).

Dordi et al. '578 differs from the instant claims in that the reference teach positioning the substrate parallel to the surface of the anode in the horizontal position but does not explicitly disclose tilting the substrate to a third angle.

Sendai et al. teach an electroplating method wherein the tilt angle is greater than 0 degrees at a time when the substrate becomes completely immersed in the fluid solution (paragraph 25); the anode is tilted from horizontal at an angle of between about 1 and 10 degrees (paragraph 91); and the central axis of the substrate proximate is centered on the electrolyte solution (figures 11-12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by tilting the substrate to a third angle as taught by Sendai et al., because tilting the substrate would prevent air bubbles from remaining on the surface to be plated, thus enhancing plating uniformity. It would have been obvious to one having ordinary skill in the art at the time the invention was made to recognize that the intermediate position of the substrate would be parallel to the surface of the anode when the anode is tilted at an angle as taught by Sendai et al. while the tilt angle of the substrate is reduced to horizontal as disclosed by Dordi et al. '578, since the tilt angle of the substrate would overlap the angle of the anode.

Addressing claim 24, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 by tilting the anode as taught by Sendai et al., because tilting the anode would prevent air bubbles from remaining on the surface to be plated and would enhance plating uniformity.

Regarding claim 25, Dordi et al. '578 teach the anode is not tilted (figure 6).

Regarding claim 26, Dordi et al. '578 vertically displacing the substrate while the substrate is immersing inside the plating solution (column 39 lines 12-16).

Claims 5, 6, 10 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dordi et al. '578 in view of Sendai et al., and further in view of Wang et al.

Dordi et al. '578 and Sendai et al. teach the method as described above. The difference between the reference to Dordi et al. '578 and the instant claims is that the reference does not explicitly teach oscillating the substrate.

Wang et al. teach that it is desirable "to vibrate the substrate, e.g., substantially vertically and/or horizontal [sic], relative to the electrolyte solution" (paragraph 81) in order to "enhance the fluid flow of the electrolyte solution into the features contained on the plating surfaces."

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. '578 and Sendai et al. by vibrating or oscillating the substrate as taught by Wang et al., because it would

enhance the fluid flow of the electrolyte solution into the features contained on the plating surfaces, and because it would enhance metal film deposition rate within the features.

(10) Response to Argument

Applicants cite paragraph 24 of Patent Application Serial Number 10/268284, which states that "plating cell 100 may be horizontally positioned or positioned in a tilted orientation, i.e., where one side of the cell is elevated vertically higher than the opposing side of the cell, as illustrated in Figure 1", as support for the limitation of "the anode is not tilted" as recited in claim 25.

The examiner asserts that the statement from paragraph 24 of Patent Application Serial Number 10/268284 does not provide a clear and explicit support for the limitation of "the anode is not tilted" as recited in claim 25. A plating cell that is horizontally positioned does not necessarily mean that the anode is not tilted.

Applicants state that there is no teaching, suggestion, or motivation in the references to Dordi et al. and Sendai et al. for the substrate to be held at three angled positions.

The examiner acknowledges that the references to Dordi et al. and Sendai et al. taken individually do not teach the sequence of three angled positions; however, the combination of Dordi et al. and Sendai et al. teach the three angled positions.

Dordi et al. teach a method of immersing a substrate having a seed layer formed thereon by tilting the substrate with a tilt angle (i.e., first tilt angle) and vertically

displacing the substrate into an electrolyte solution (column 37 lines 35-58, Fig. 30). As a substrate is vertically displaced into the solution, the tilt angle changes to an angle closer to horizontal as the substrate is immersed deeper into the electrolyte solution. After full immersion of the substrate face, the tilt angle becomes zero and the substrate is horizontal (i.e., second tilt angle). Dordi et al., therefore, discloses the substrate being held at two positions, a first angled position and a second tilt angle (i.e., horizontal position or any intervening angle between the first tilt angle and horizontal) as acknowledged by the Applicants on page 13.

Dordi et al. suggest that changing the tilt angle (from a first tilt angle to a second tilt angle) as the substrate is vertically displaced into the solution enables the substrate to be immersed at a suitable rate that is not too rapid or too slow (column 38 lines 3-44). Dordi et al. explain that "bubble 3002 in FIG. 31 is created when the substrate 22 is immersed within the electrolyte solution too rapidly. Alternatively, when the substrate 22 is immersed within the electrolyte solution at too slow a rate, as illustrated in FIG. 32, then air bridge 3102 forms between the substrate 22 and the electric contact element 67. When substrate 22 is immersed in the electrolyte solution at the suitable rate, neither a bubble 3002 nor an air bridge 3102 is formed between the substrate 22 and the electric contact element 67 within the electrolyte solution" (column 38 lines 3-12).

Sendai et al. teach electroplating a substrate being inclined at an angle that is parallel to the angle of an anode (paragraph 91). In addition, Sendai et al. teach immersing the substrate at a tilt angle and plating the substrate at a tilt angle prevents air bubbles from remaining on the surface of the substrate, thus preventing defects in

the plated film (paragraph 96). Therefore, Sendai et al. teach electroplating a substrate at a third angle.

It would have been obvious to one having ordinary skill in the art to have tilted the substrate at a tilt angle from a first tilt angle to a second tilt angle as the substrate is vertically displaced into the solution as taught by Dordi et al., because it would enable the substrate to be immersed at a suitable rate (column 38 lines 3-44), thus preventing the formation of air bubbles. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Dordi et al. by tilting the substrate to a third angle as taught by Sendai et al., because tilting the substrate would prevent air bubbles from remaining on the surface to be plated, thus enhancing plating uniformity.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Luan Van

Conferees:

Nam Nguyen

Jennifer Kolb-Michener